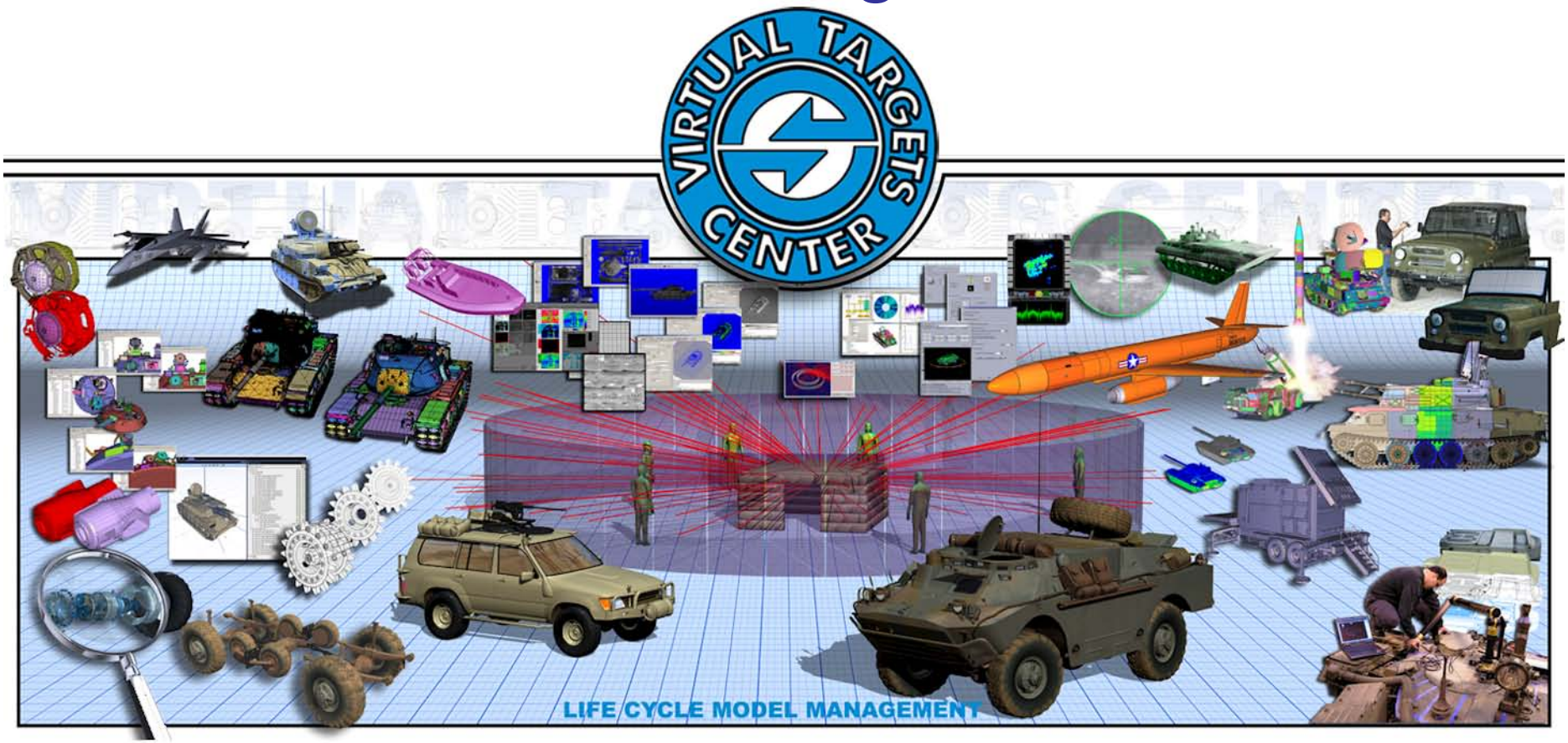
Threat Virtual Target Validation



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Report Documentation Page

Form Approved
OMB No. 0704-0188

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1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
2005		**00-00-2005 to 00-00-2005**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Threat Virtual Target Validation	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Army Research Engineering & Development Command,Picatinny Arsenal,NJ,07806-5000**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
Modeling and Simulation Conference, 2005 Dec 12-15, Las Cruces, NM

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**28**	

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Outline

What is a Virtual Target
Threat Virtual Target Validation
Eight Step Validation Process

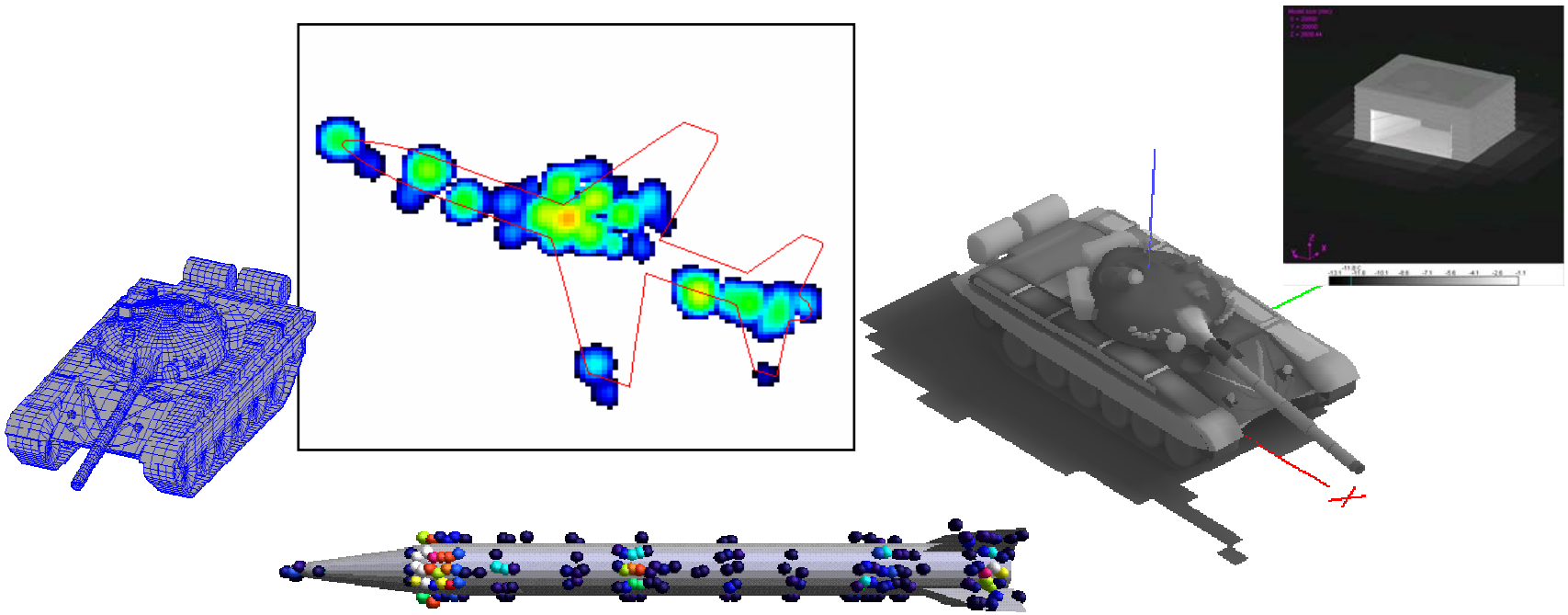
Step 1. Data Request
Step 2. Virtual Target Preparation
Step 3. On Demand Reconstitution
Step 4. Configuration Check
Step 5. Predictive Runs
Step 6. Comparative Analysis
Step 7. SME Review of Results
Step 8. Validation Summary Report

What is a Virtual Target

Virtual Targets

“digitized structural information representing foreign military equipment”

“digitized spectral images of foreign military hardware.”



Army Pamphlet 73-1, Test and Evaluation in Support of Systems Acquisition

Threat Virtual Target Validation

DOD regulation 5000.2-R requires each threat representation subject to validation procedures to establish and document a baseline comparison with its associated threat and to determine the extent of the operational and technical performance differences between the two throughout the life cycle of the threat representation.

If M&S is going to support a T&E event then threat validation will occur.

What Users Want

User Desire

Geometric Representation

Data Generation

Signature Variability/ Measurement Data

Metrics

Virtual Target Performance Assessment & Validation

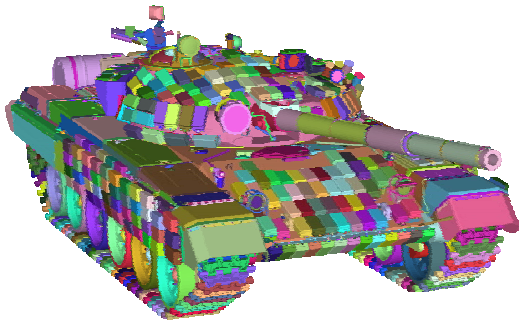
Validated Simulation Model (user specific Intended use)

Simulation Development

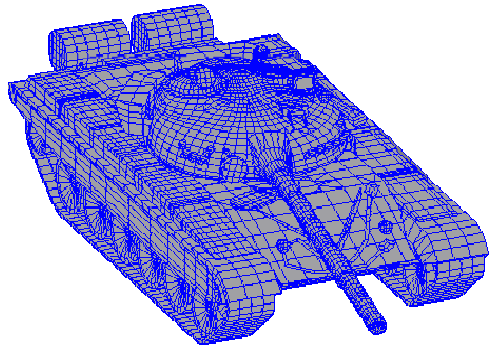
Validated Simulation Input

What Needs to be Done?

RF/MMW Geometry



IR Geometry



CAD Representation

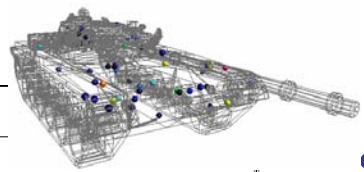
High fidelity, millions of facets,
nut and bolt detail, material properties

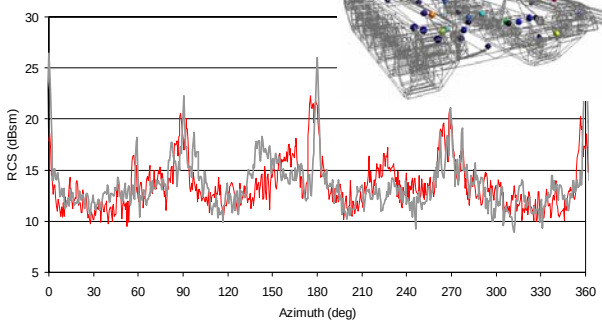
Detailed mesh, thousands of facets,
thermal regions and attributes

Xpatch

Example
State-of-the-art
Predictive Codes

MuSES

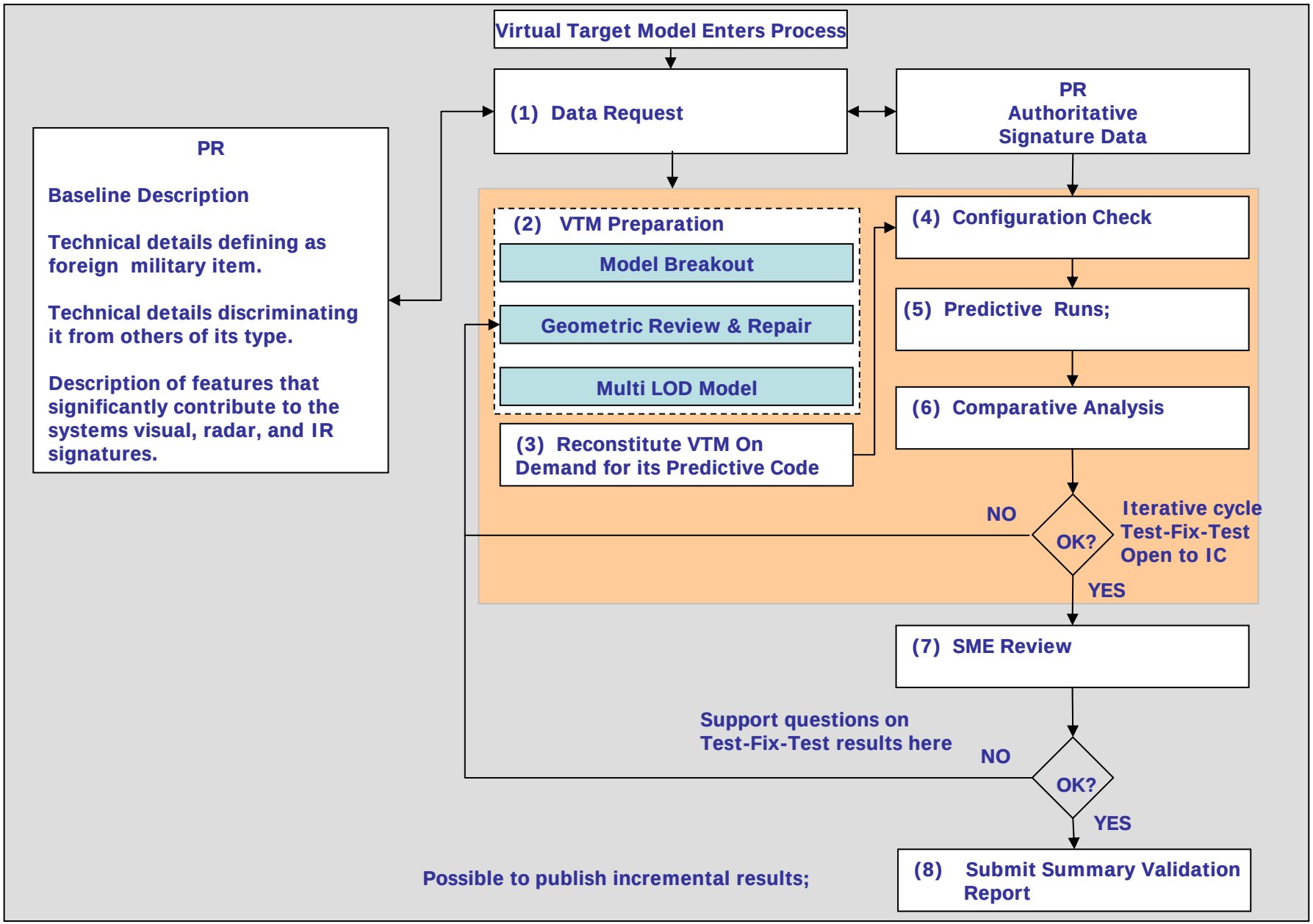




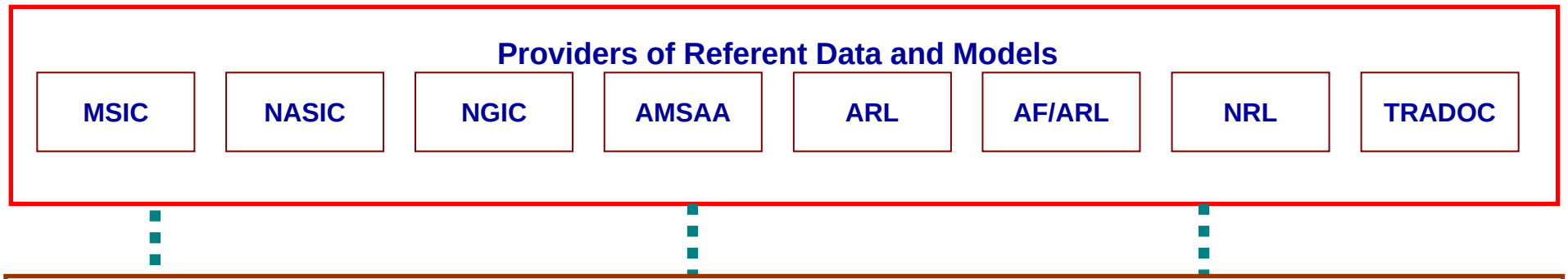
Synthetic data that is used in
Simulation Model Development
- Radar multiscatterer model
- IR realtime textured model

Couple Geometry Development to Electromagnetic Signature Analysis

Eight Step Validation Process



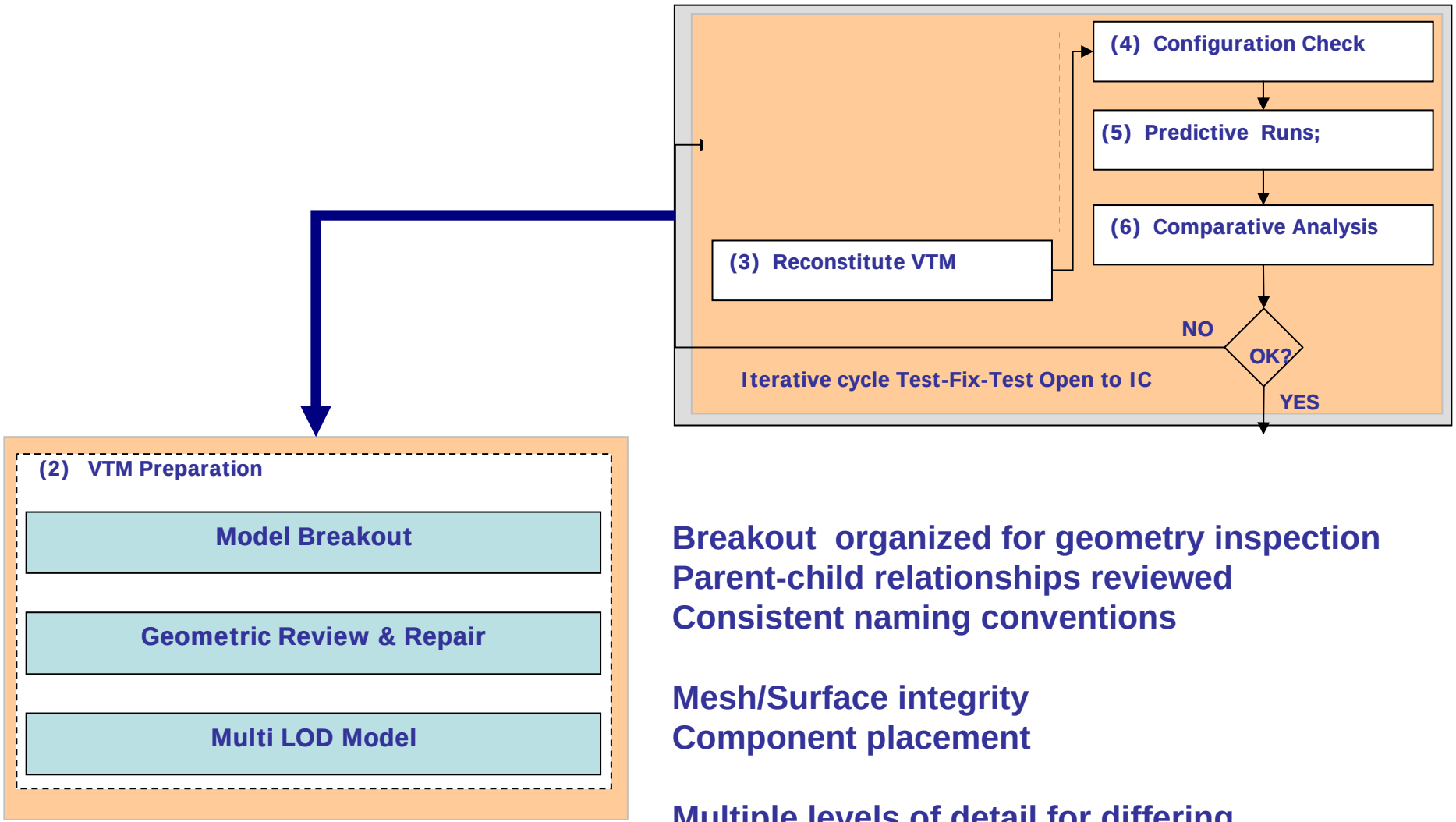
1. Data Request



Information Requested

- Baseline descriptions
- Technical details
- Discriminators
- Critical features
- Authoritative signature data in bands of interest
- Approved referent data

2. Virtual Target Preparation

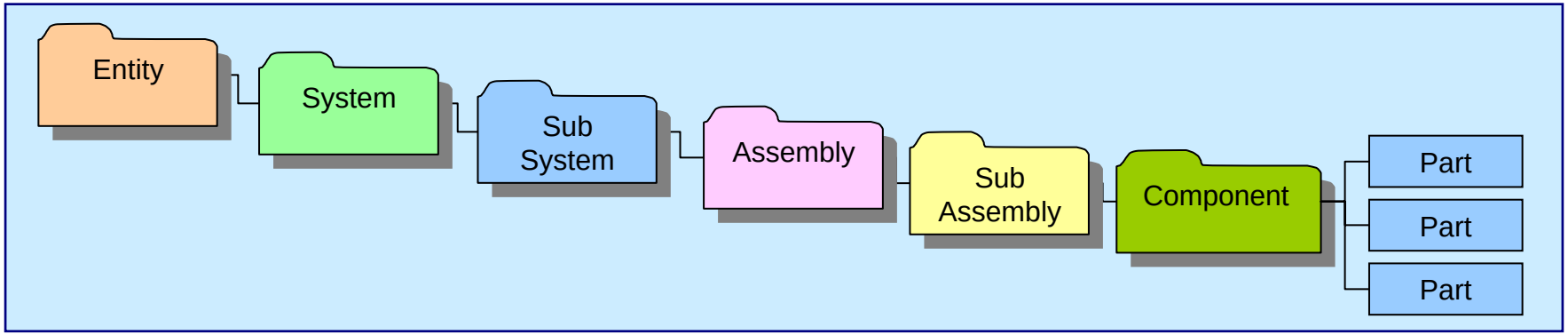


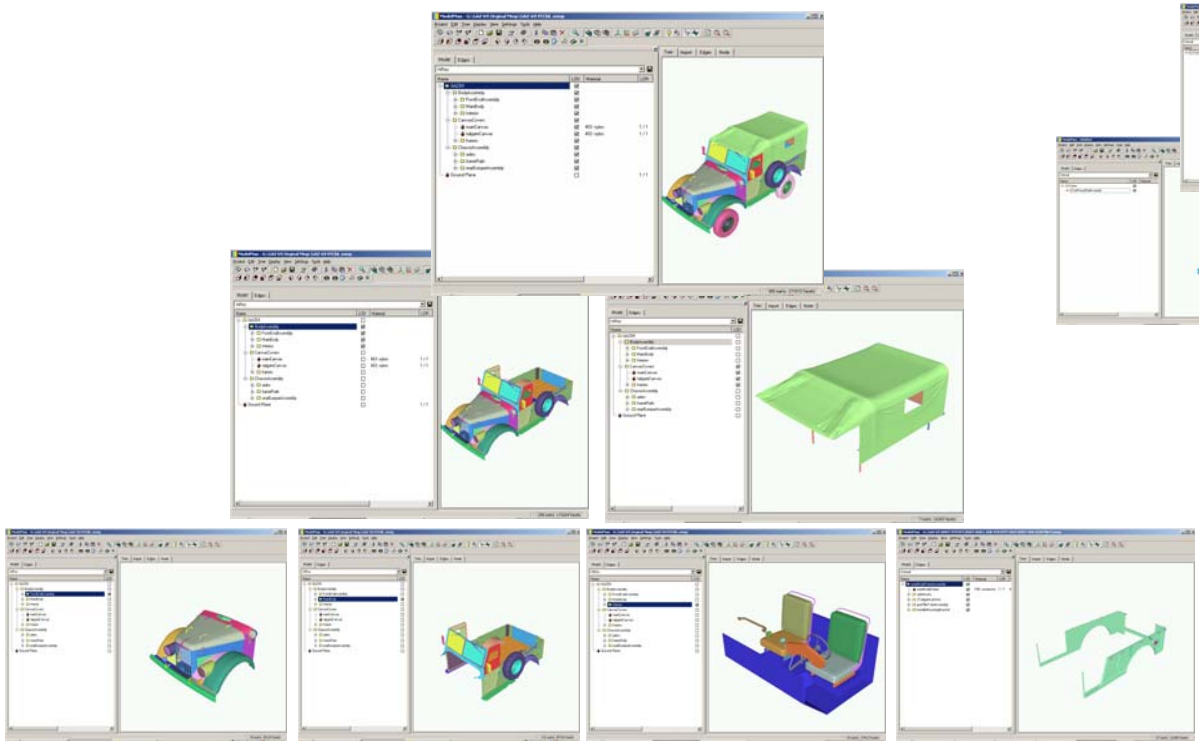
Breakout organized for geometry inspection
Parent-child relationships reviewed
Consistent naming conventions

Mesh/Surface integrity
Component placement

Multiple levels of detail for differing simulation fidelity requirements

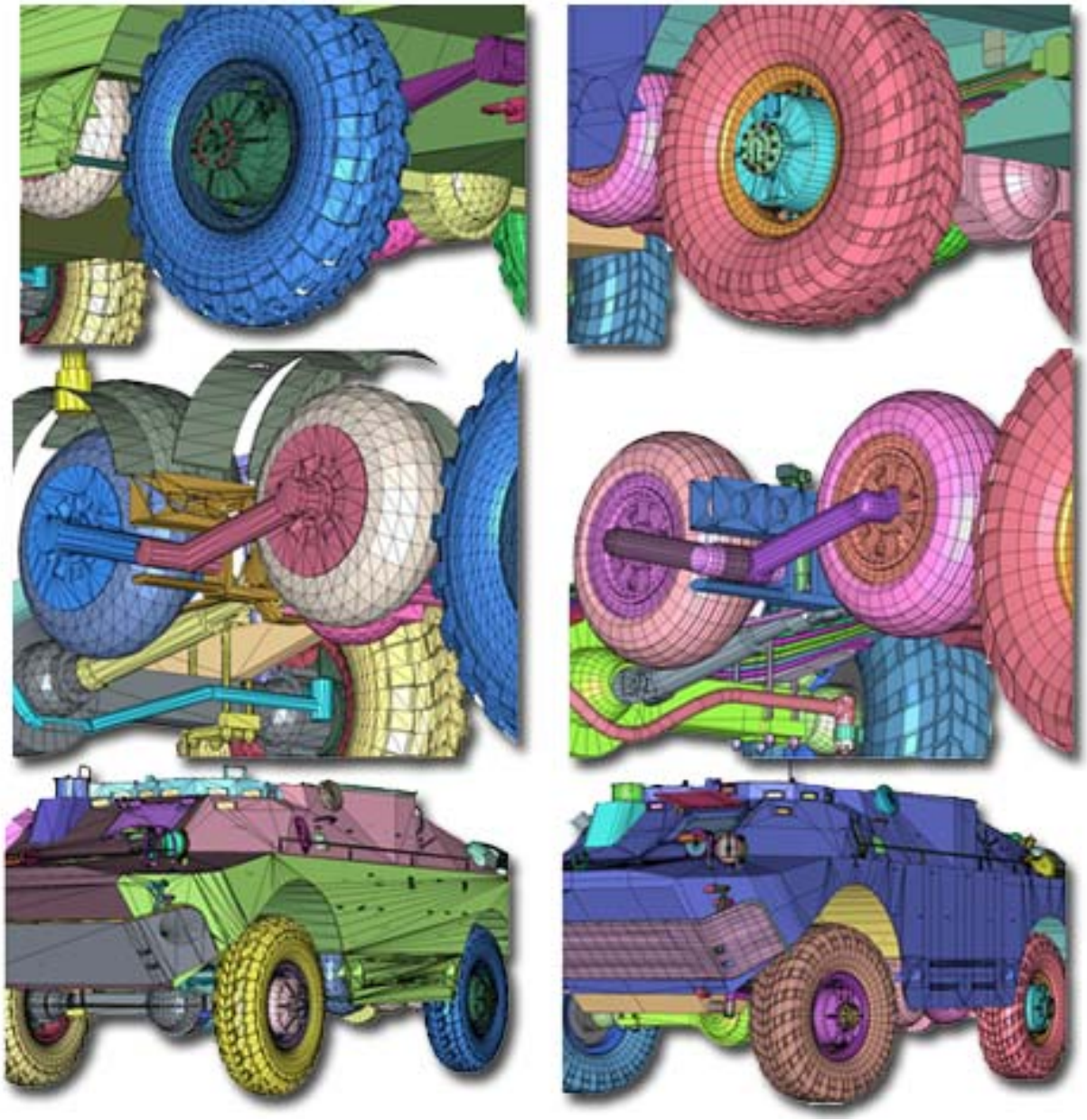
Breakout into Component Level Parts



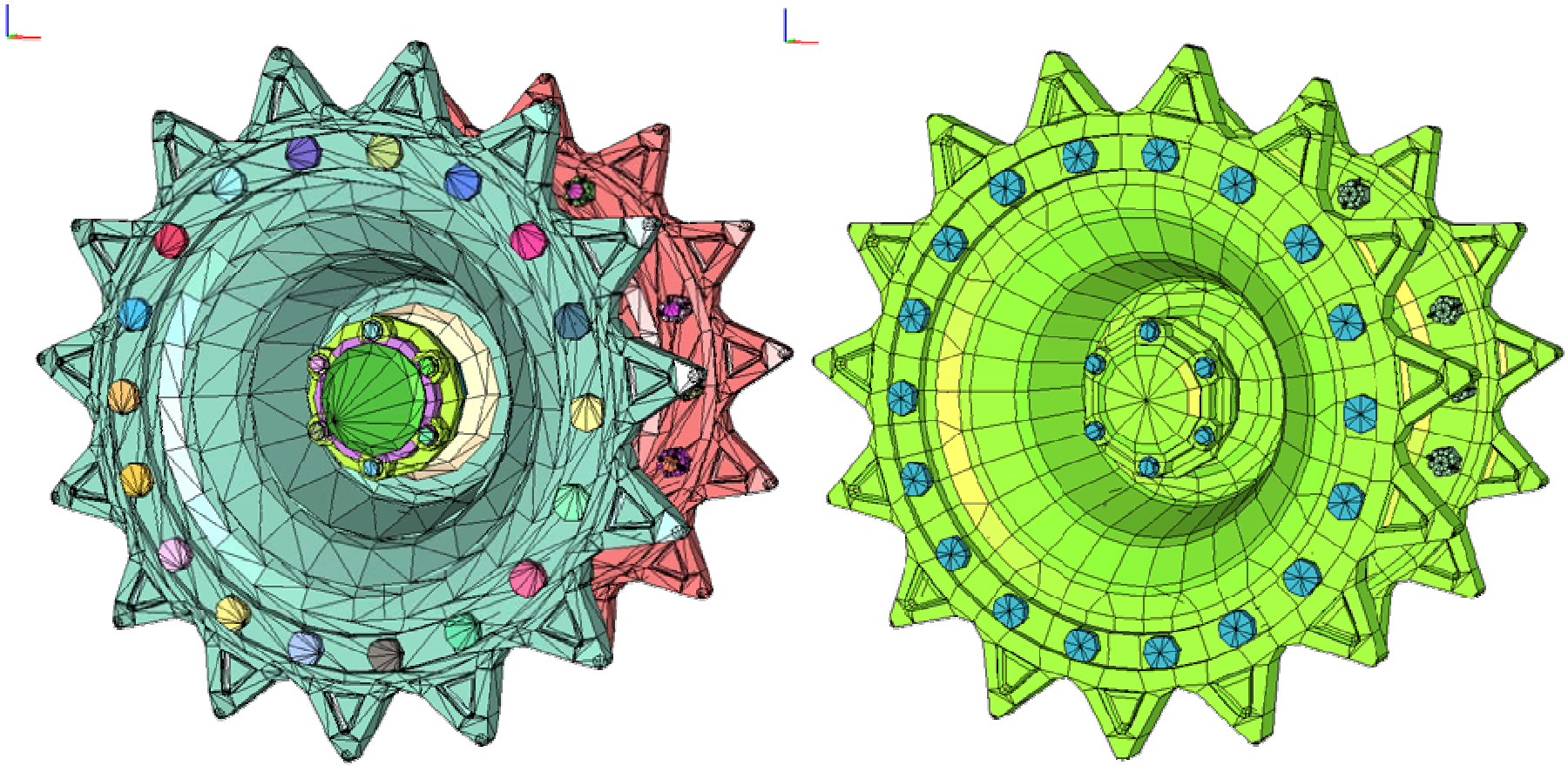


Clean Up Geometry

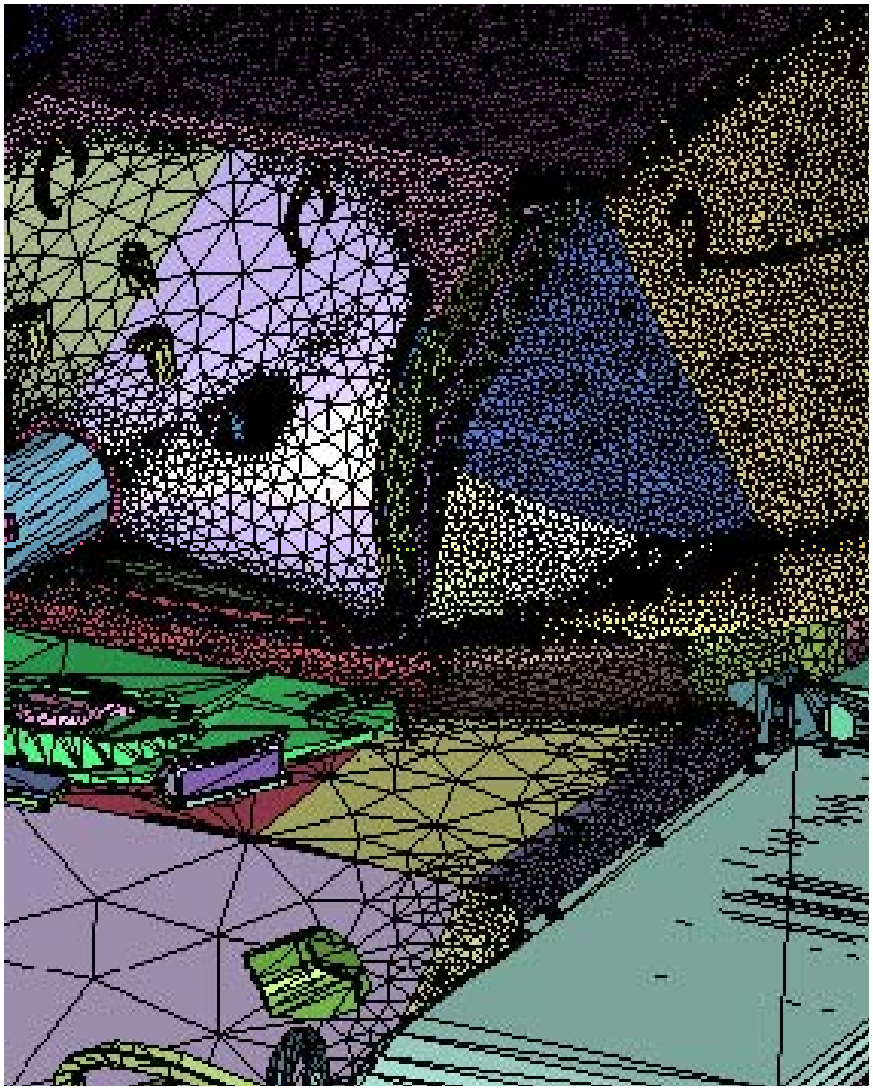
- Missing facets
- Disproportionate facets
- “T” meshes
- Bare edges
- Improper Association

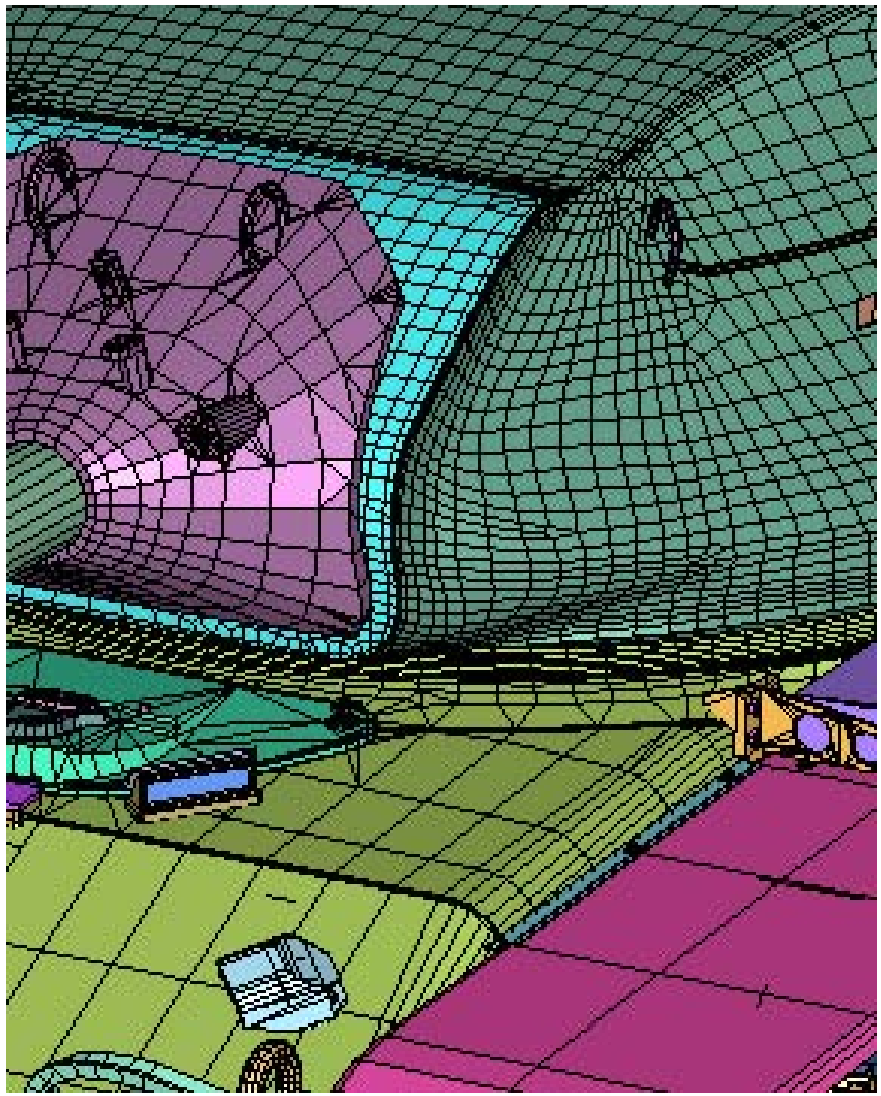


Create Uniform Geometry

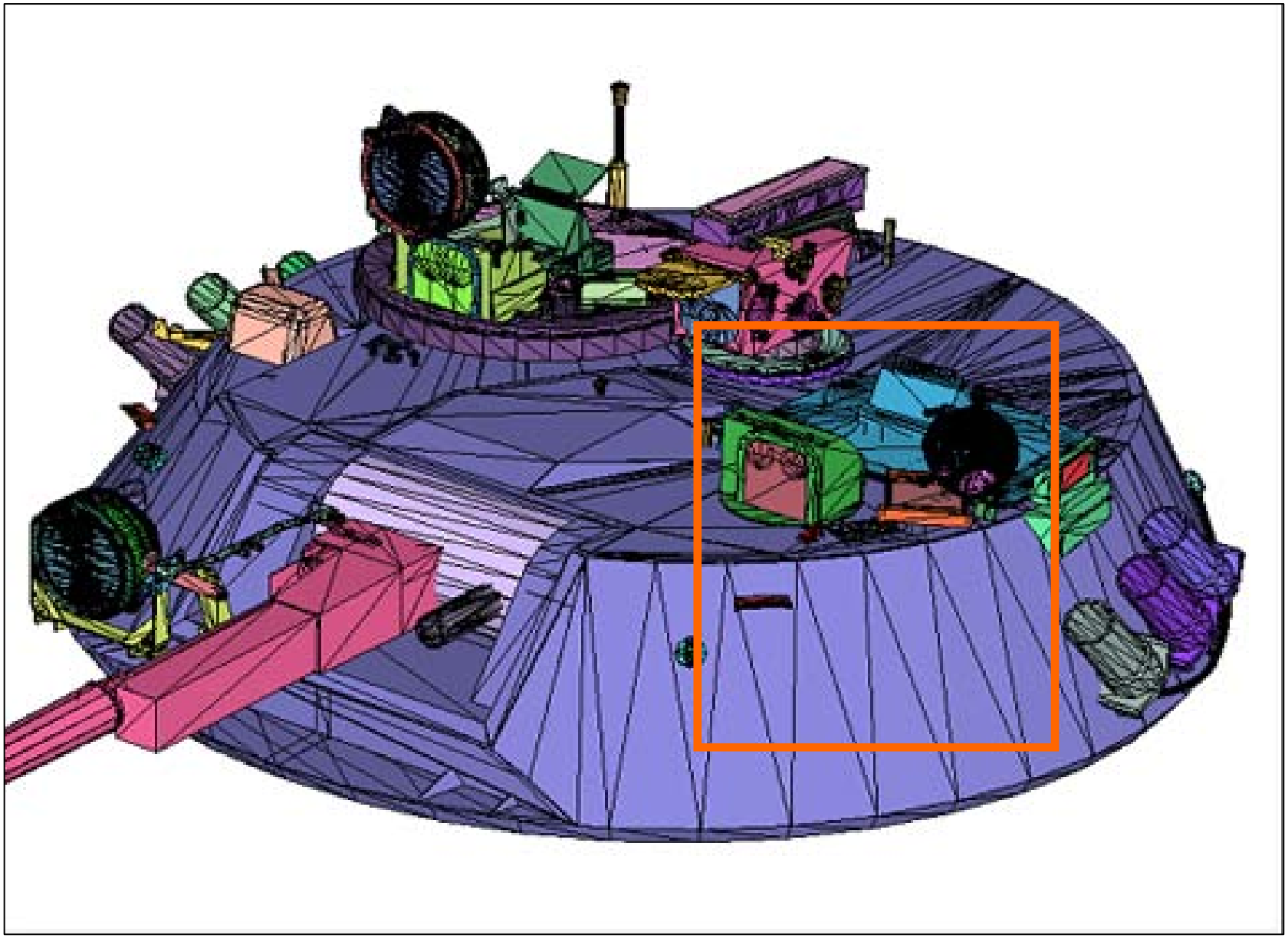


Reduced Facets-Resolution Retained

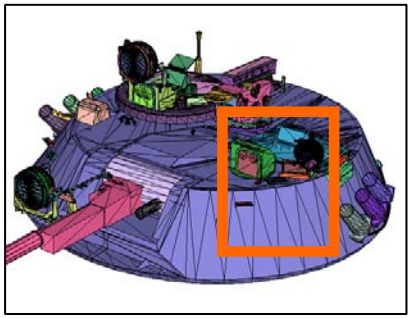


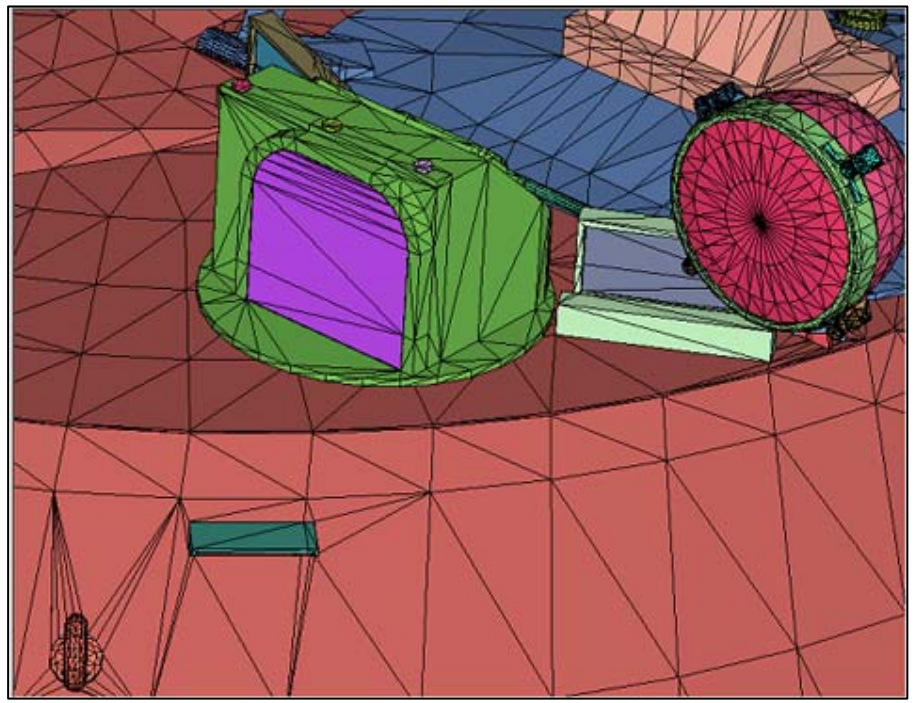


Artifacts of Translation



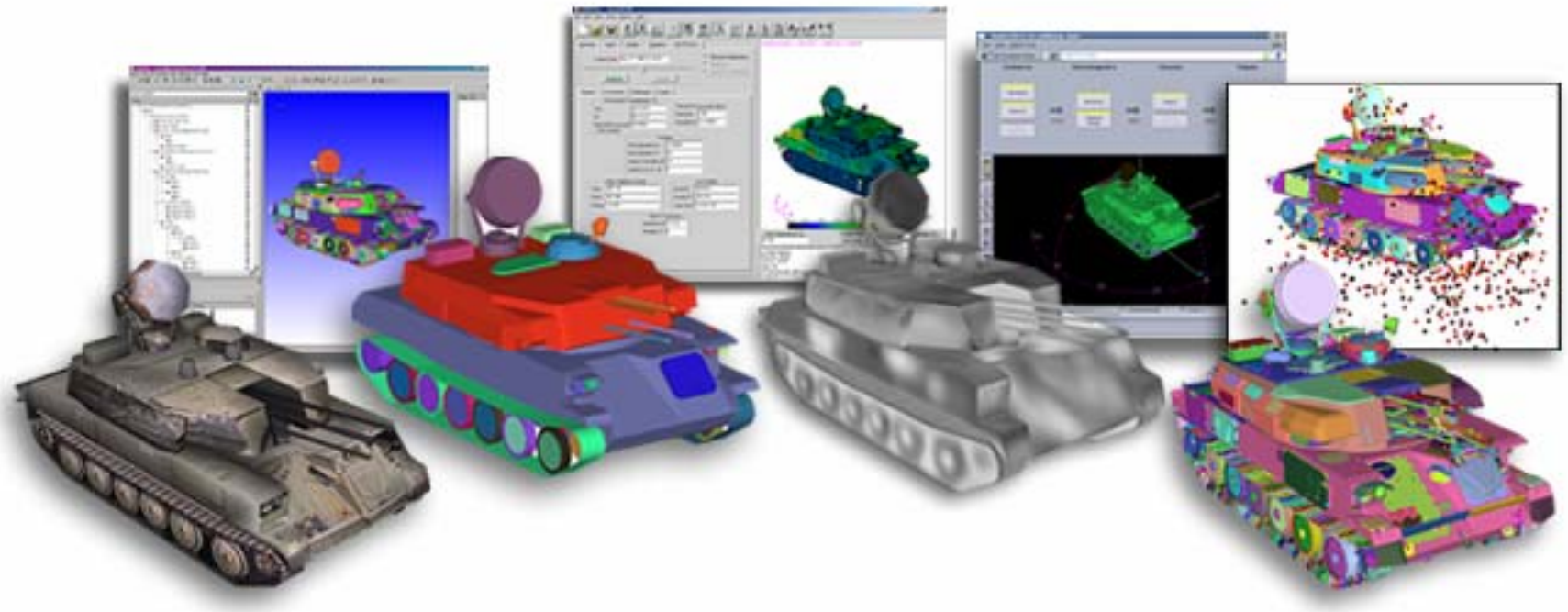
Corrected Artifacts





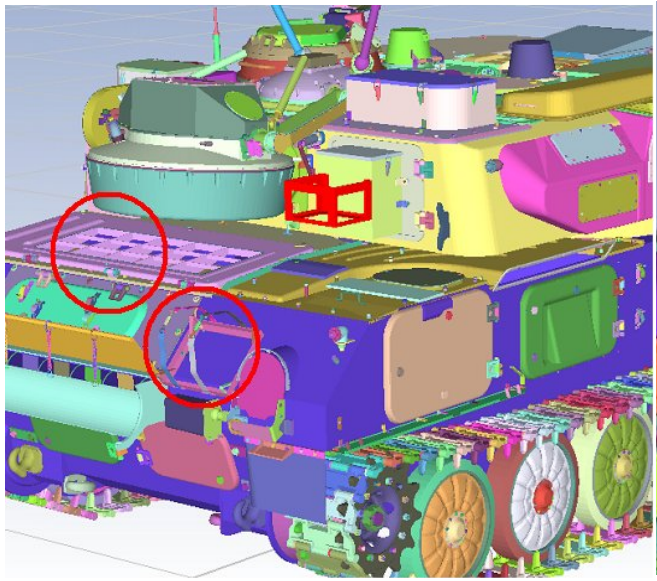
3. On Demand Reconstitution

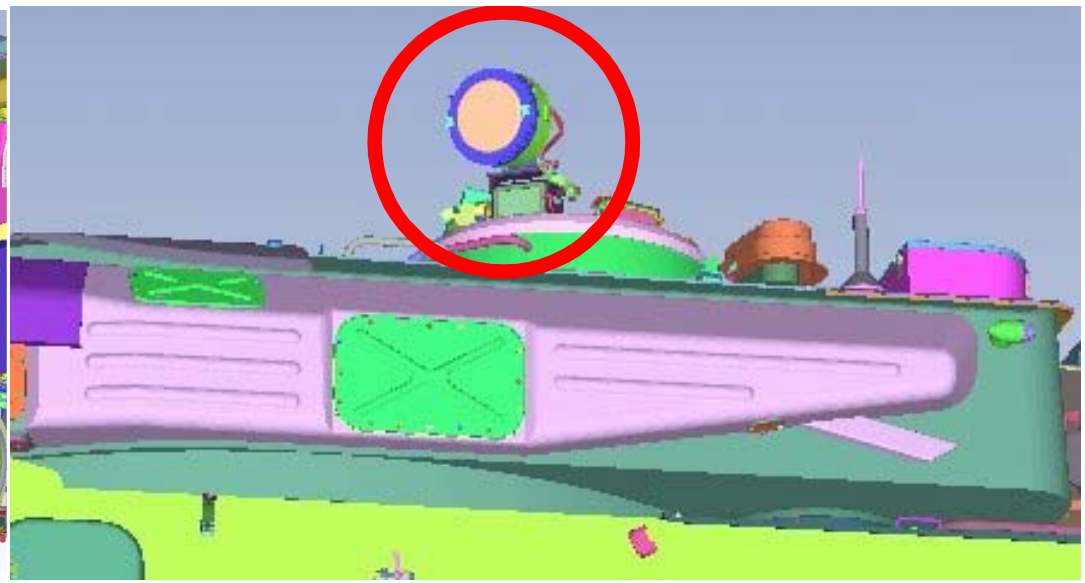
- Put models back together
- In context of use



4. Configuration Check

Check to referent data Existence, Accuracy, Orientation

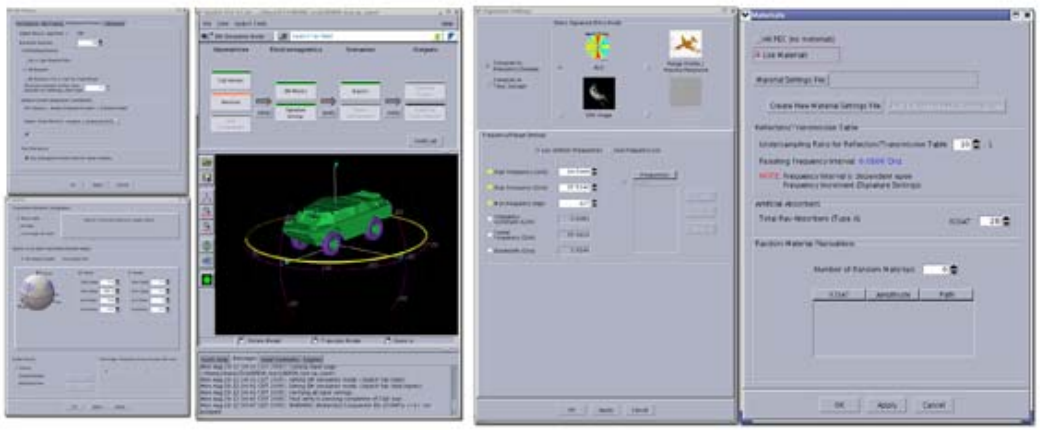




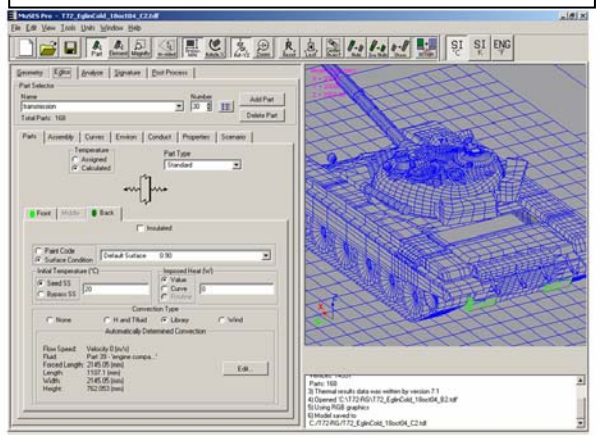
5. Predictive Runs

- Appropriate analytical and signature prediction technique
- Form of output data depends on anticipated intended use
- Visualization- visual rendering of scene generation code
- IR- synthetic signature calculated for specific geographic and environmental condition
- Radar- raw IQ data, RCS plot, or ISAR image

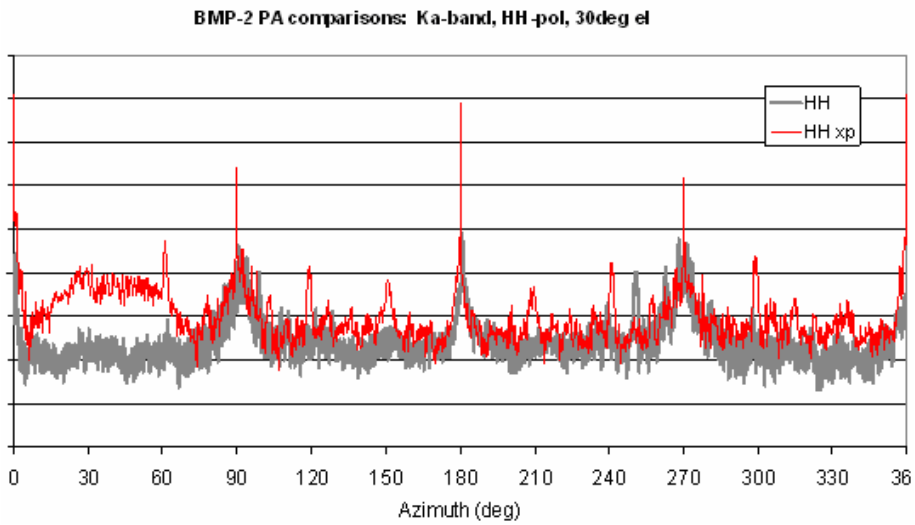
Xpatch Simulation



MuSES Simulation

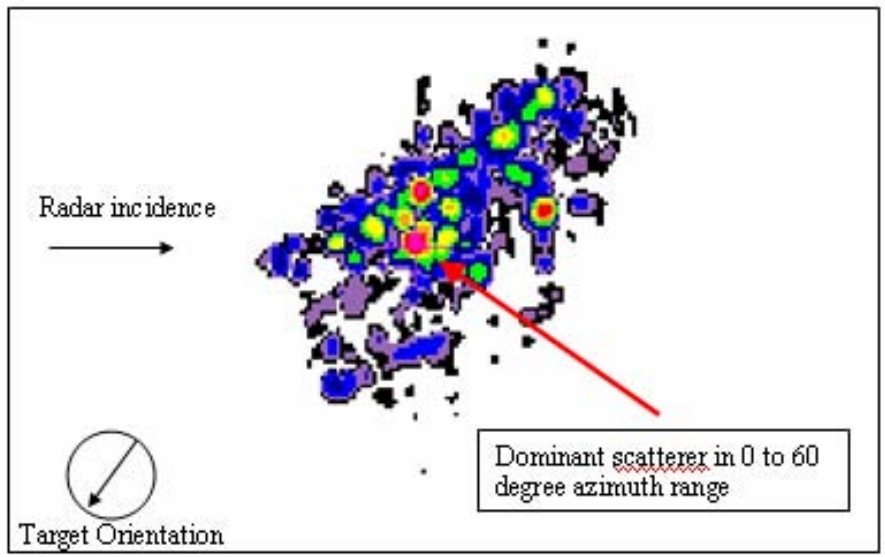


6. Comparative Analysis



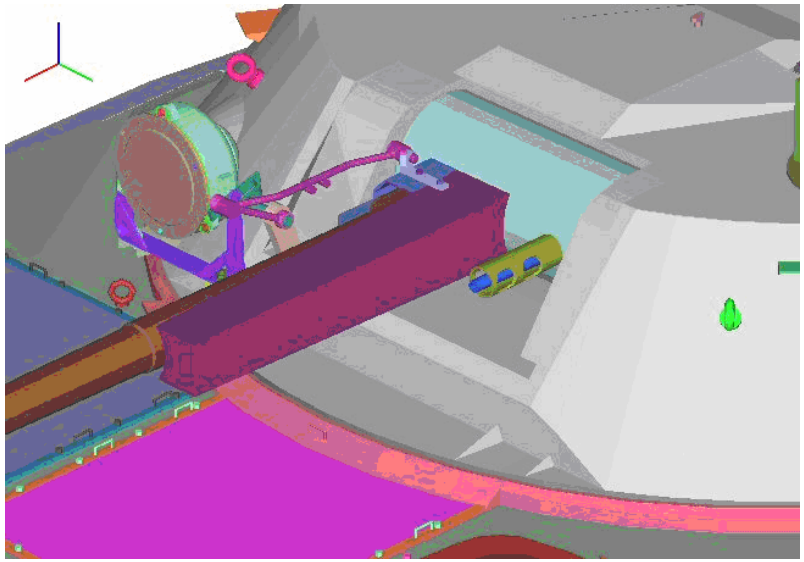
Issue in 0-60 degree azimuth region

Dominant scatterer shown near turret



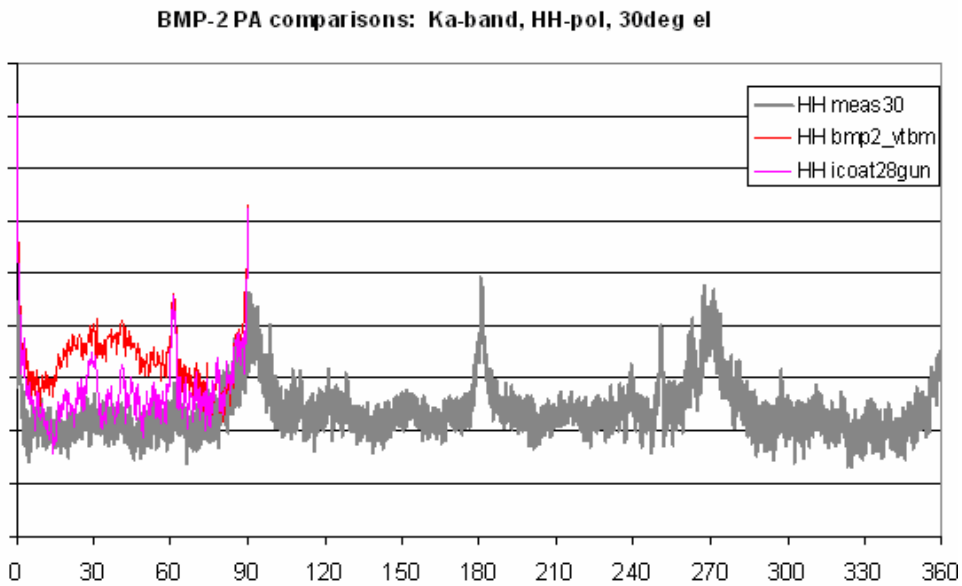
Iterate as necessary

Ka-band BMP-2 Error at 30 Deg El



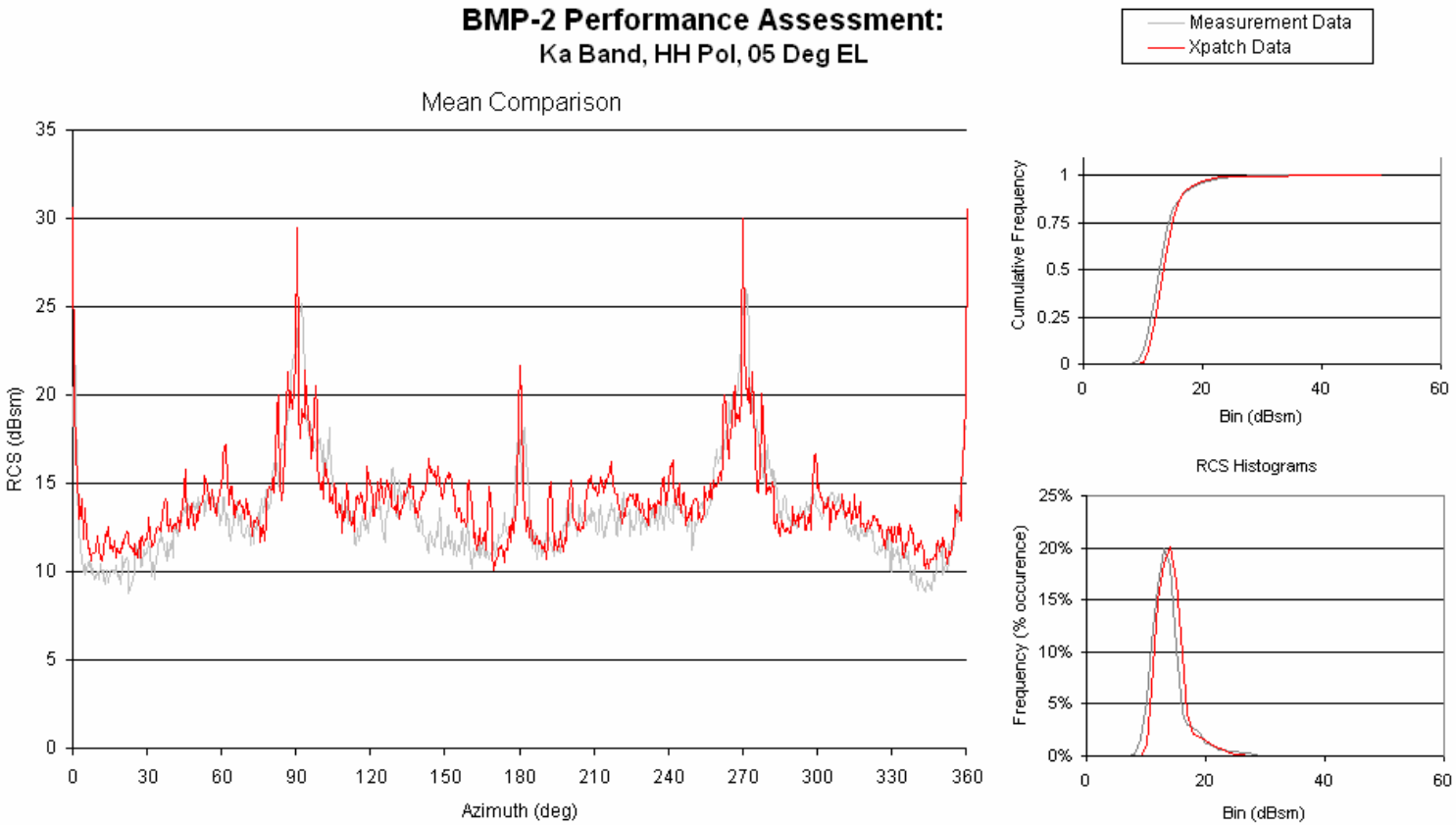
Gun shroud and mantlet suspect

Treat gun assembly with icoat 28: absorbing



Ka-band BMP-2 Valid RCS at 5 Deg El

Same model is good at other angles



Measurement Data Global Statistics (dBsm)

Arithmetic Mean: 14.7936 Median: 12.7944

Xpatch Data Global Statistics (dBsm)

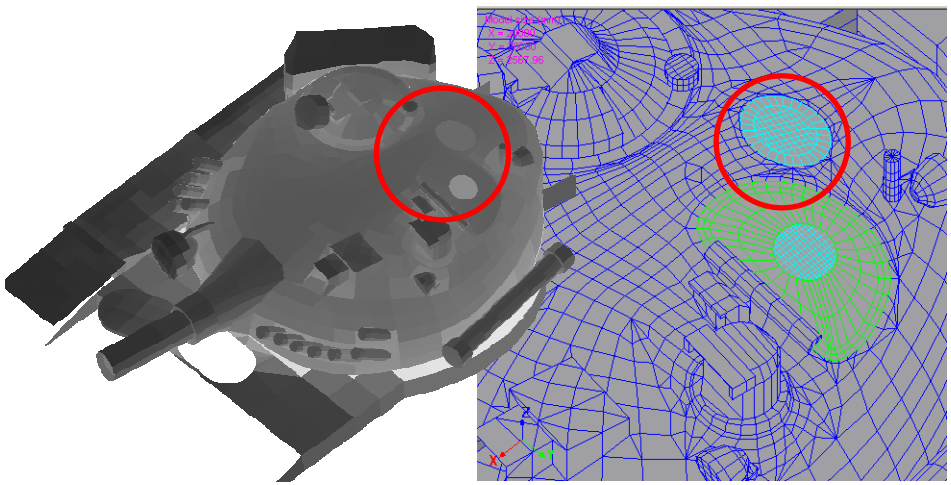
Arithmetic Mean: 15.3375 Median: 13.4644

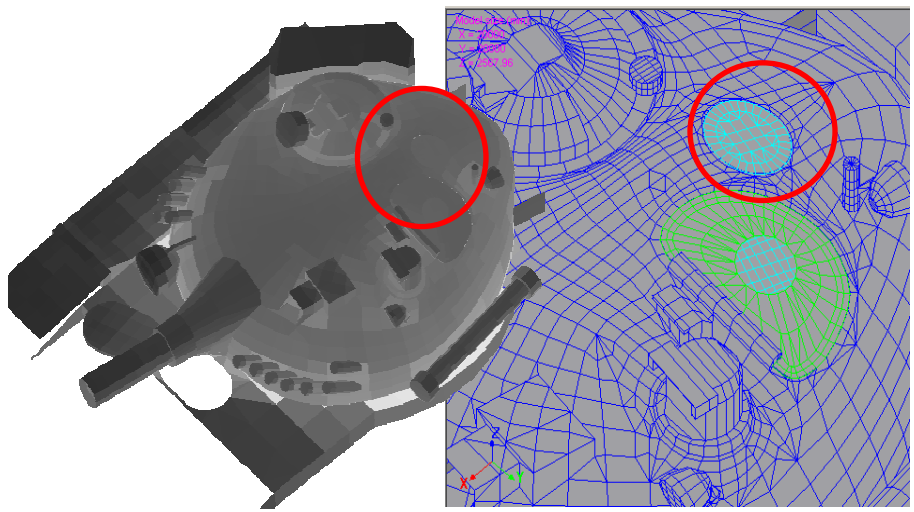
Valid RCS comparison at 5deg elevation, HH-pol

Dense Mesh Evaluation

Turret roof and gunner's hatch, snorkel port, and shell eject port sensitive to mesh density in infrared predictive code

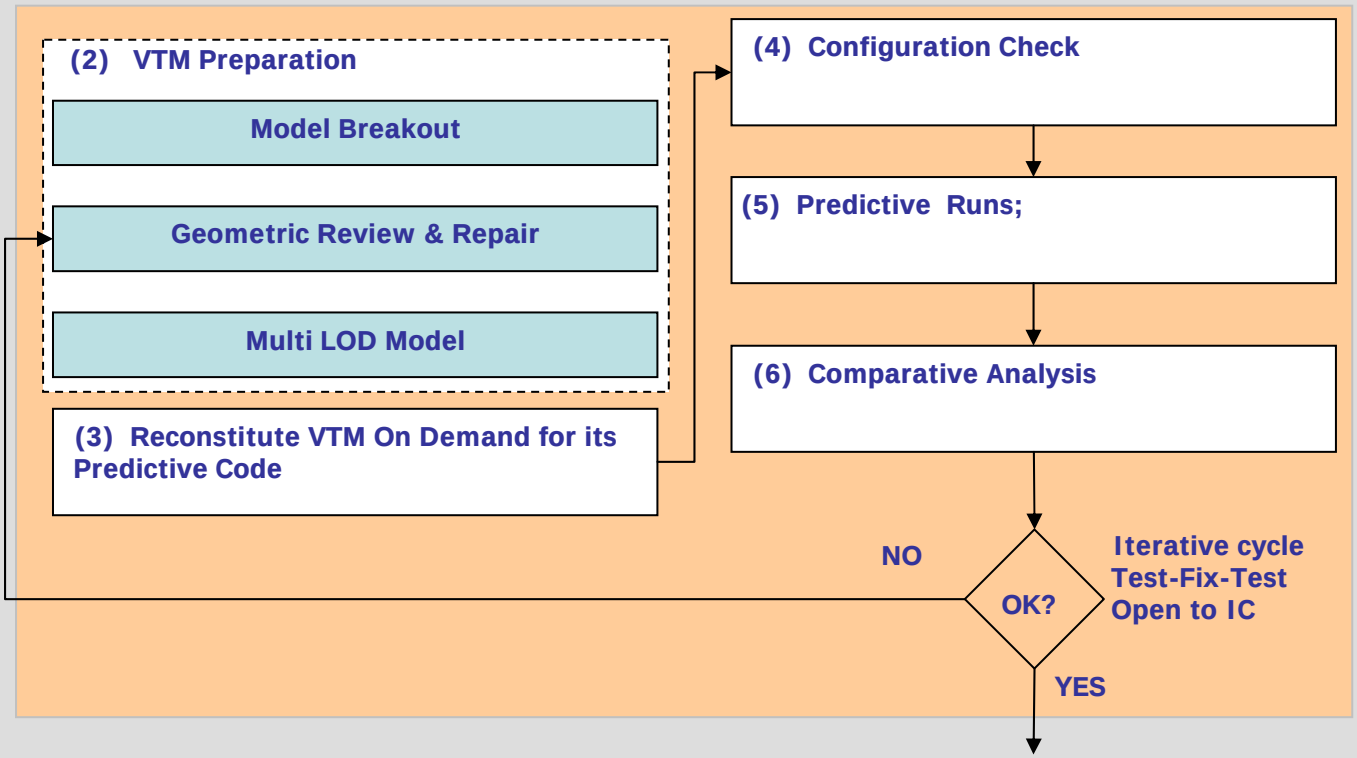
Dense Mesh Artifact





Relaxed Mesh

Spiral Test-Fix-Test Process



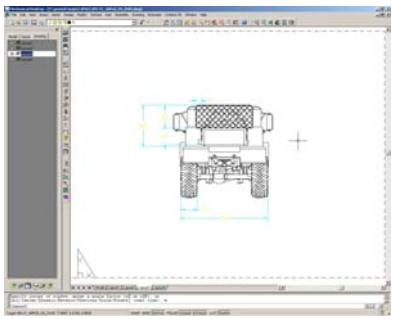
Virtual target assessment is a spiral, test-fix-test process
Iterative refinement
Intermediate steps not necessary for SME involvement
Development loop is always open to SME

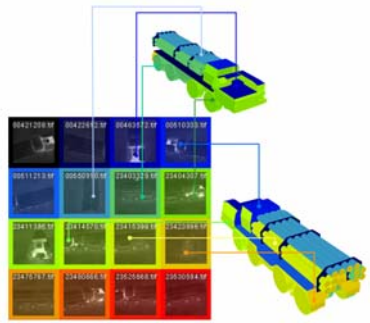
7. SME Review of Results

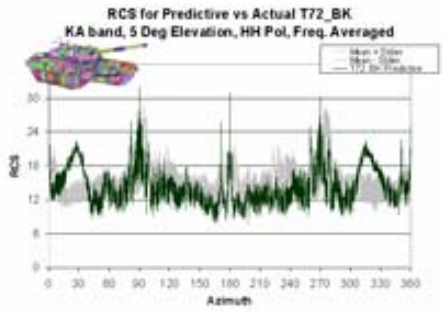
- SME conducts review
  - Confirms comparative analysis was conducted with agreed to methods
  - Appropriate intelligence and referent data was applied
  - Results satisfy agree-to-metrics

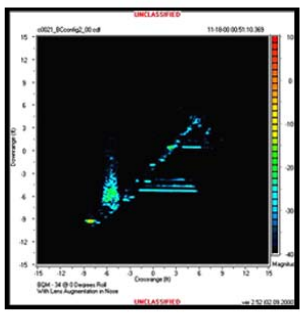
Subject Matter Experts

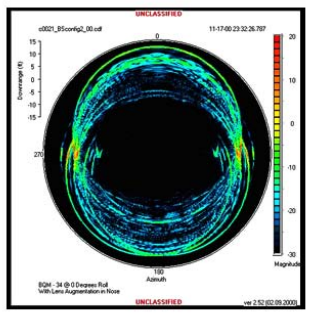
MSIC | NASIC | NGIC | AMSAA | ARL | AF/ARL | NRL | TRADOC

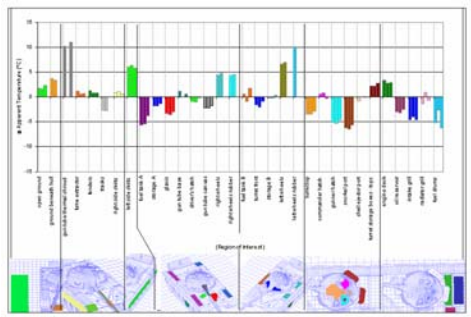


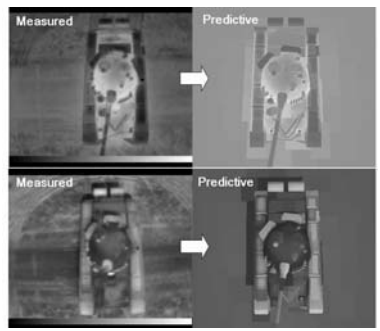












8. Validation Summary Report

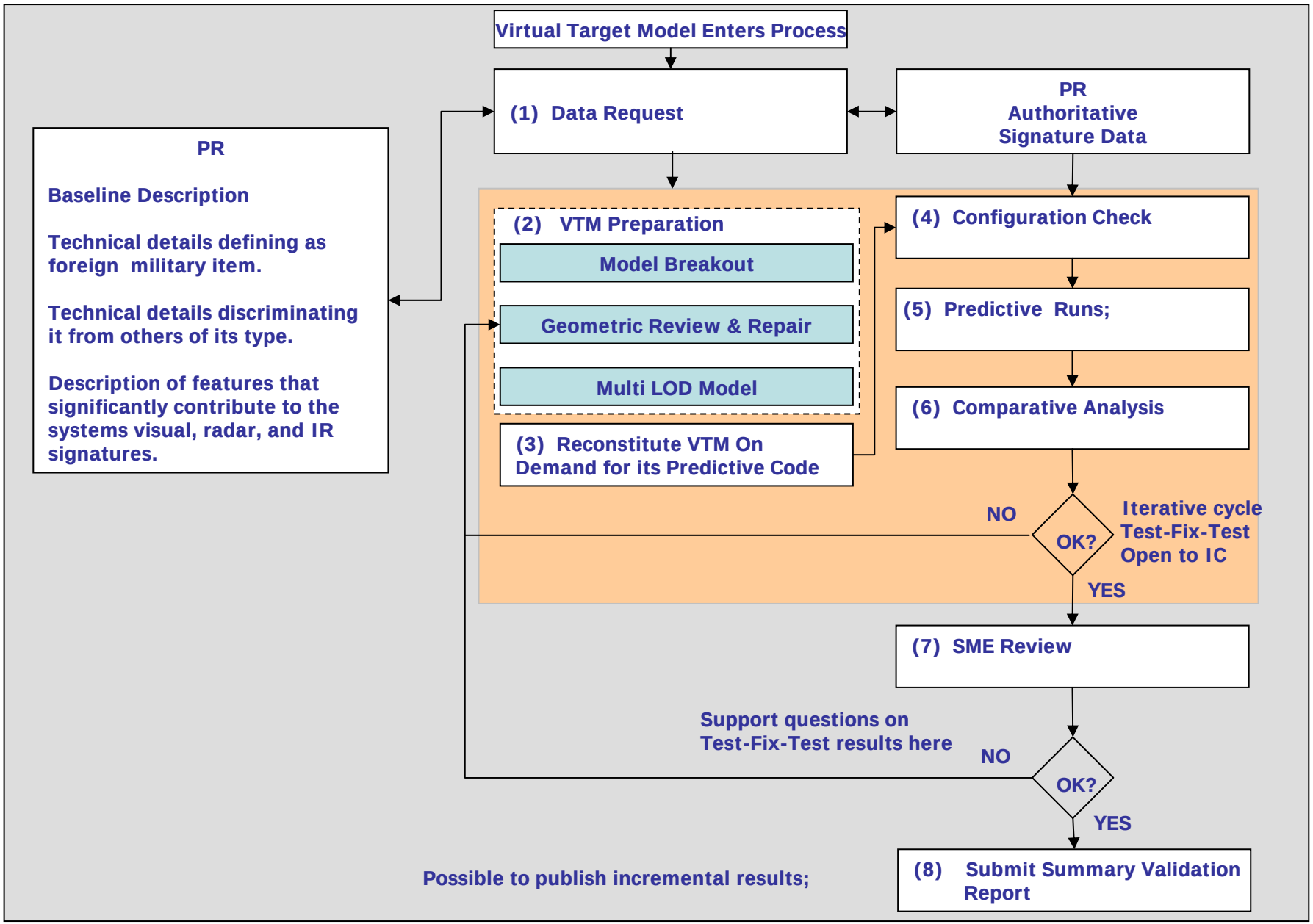
Threat Virtual Target Validation Memorandum

Memorandum contains
Description of Virtual Target
- **Intended use**
- **Identified limitations**
- **URL address for location of electronic validation database**
- **Standard validation signature page for Army TVWG members**

Supporting data maintained in electronic database
- **available for review and download**

SUMMARY REPORT REPLACES PREVIOUS UNWIELDY VALIDATION REPORTS

Eight Step Validation Process



Questions or Discussion?